6. ASTRONAUT TRAINING

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GENERAL TRAINING

Academic Training

General training for the flight crews preparing for the Apollo Mission begins with an academic program designed to compliment or improve the pilot's technical knowledge of space flight. The courses include such subjects as the following: geology, astronomy, physics of the upper atmosphere and space, flight mechanics, digital computers, guidance and navigation, spacecraft onboard computers, medical aspects of space flight, rocket propulsion systems, aerodynamics, communications, and meteorology.

It is obvious that the courses are space mission oriented. For example, the complete mission navigational tasks from lunar insertion to earth entry require a knowledge of 8 of the 12 items listed. In addition to increasing the probability of mission success, these courses will provide competent observers in such non-operational disciplines as the geosciences. These aspects are covered comprehensively with lectures, laboratory periods, and field trips scheduled in six separate series that will continue from the present until completion of the lunar missions.

Environmental Familiarization

The next phase of general training covers environmental familiarization and contingency aspects of the Apollo mission.

The acceleration programs as provided on the NASA and Navy centrifuges (fig. 6-1, 6-2), will provide evaluation of spacecraft systems such as control, displays, pressure suits, and restraints during launch and entry acceleration under normal and emergency conditions.

The effects of vibration on crew members will be studied where applicable. The noise environment will be simulated in the Apollo Mission Simulator.

Training pressure suits are provided for the flight crew to gain experience in donning and doffing the suits, walking at various degrees of pressurization, mobility in spacecraft mock-ups and mission simulators, and operations under design conditions in altitude chambers.

Similar training will be provided for operational familiarization with the portable life support systems.

Flight crews will participate in altitude chamber-spacecraft tests and checkout. Weightlessness and lunar gravity training will continue through the use of the inclined platform and aircraft trajectory techniques.

Survival Training

The three basic survival conditions, for which training is required, are for tropic (fig. 6-3), desert, and water landings. This training is supported through Air Force and Navy survival schools. Training for all aspects of water recovery will be accomplished in a flotation tank and in open water.

Another aspect of general training is that of astronaut participation in the engineering development of the launch vehicles, the spacecraft, and their various subsystems. This is accomplished through participation in design reviews, engineering simulations, spacecraft and launch vehicle development tests, and through individual engineering assignments. Each astronaut is assigned to participate in and follow through various engineering developmental aspects of the program. This participation provides a means of maintaining individual and group knowledge as well as providing crew contributions to the program development.

Operational Training

Operational training will be conducted with a variety of fixed-base and free-flight simulators. A major portion of the training will be conducted on full-mission simulators that will have the capability of simulating Apollo missions from launch to landings. These simulators will familiarize the flight crew with the over-all mission timing and specific tasks as determined from mission plans.

For the landing and docking maneuvers, which cannot be adequately simulated by static devices, moving-base and free-flight simulators will be provided.

Specific mission preparation (~~fig.~~ 6-4) begins approximately six months prior to the scheduled flight date and consists of operational checks in the white room, vacuum chamber, vertical assembly tower, and on the launch complex. This program will require a part or all of the crew for paticipation or observation. Also, during this period, the crew will utilize the mission simulator to practice normal and emergency procedures, guidance and navigation, control mode switching and tasks, and flight plan and mission rule refinements. In the final stages of preparation, integrated network simulations are conducted with all the world-wide ground stations and flight crews participating.

Concurrent with all other commitments, the pilots must maintain flight proficiency in high performance aircraft and helicopters.

TRAINING EQUIPMENT

Mission Simulators

Two Apollo mission simulators (fig. 6-4) will be provided; one to be located at Houston and the other at Cape Kennedy. Each will simulate the command module (CM) separately or the command and service module (CSM) combination. The internal arrangement of the command module is an exact duplicate of the particular spacecraft being simulated. The controls, displays, and window scenes will be active, and will be driven closed-loop by peripheral computing equipment. The instructor's console will contain duplicate displays and malfunction insertion units.

Apollo Part-task Trainer

The Apollo part-task trainer will be similar to, but less sophisticated than, the mission simulator. It is required to alleviate the workload on the mission simulator and to provide transition training from one flight to the next.

LEM Simulation Equipment

A contract has not been awarded for the LEM simulation equipment; however, its functions will necessarily parallel those of the CSM simulator.

The lunar landing research vehicle (fig. 6-5) will provide piloted, free-flight simulation on earth. It can simulate LEM trajectories and handling qualities for the final 4,000 feet of approach. The gimballed jet engine will provide lift for $\frac{5}{6}$ of the vehicle weight, and effectively provide a lunar gravity potential. The pilot controls hydrogen-peroxide rockets to provide the descent or ascent accelerations. Additional control rockets, mounted as on the LEM, will produce variable thrust to match LEM angular accelerations and handling qualities.

Gemini Translation and Docking Simulator

In order to provide a realistic, full-scale close proximity docking simulation, the Gemini translation and docking trainer (fig. 6-6) will be modified to accept either Gemini or Apollo modules. This equipment is mechanized, closed loop, through an analog computer. Rotation and translation motions are duplicated by use of gimbals and air-bearing rails.

TRAINING DERIVED FROM GEMINI PROGRAM

Past experience has indicated that there is no substitute for the experience gained under actual operational conditions. The Gemini missions should, therefore, serve as a proving ground and training program for many segments of the Apollo mission. For the actual rendezvous, the digital computers and radar will be operated. In addition, optical, semi-optical, and manual methods will be evaluated. After docking, maneuvers will be accomplished for altering the orbit.

Since both the Gemini and Apollo spacecraft are lifting bodies during atmospheric flight, the techniques of lift-vector control during entry to arrive at a preselected landing point can be evaluated.

The aero-medical functions of the long duration flights will assess the effects of zero - g, required inflight exercises, and sanitation methods and procedures.

Many of the Gemini systems that are similar to those of the Apollo spacecraft can be evaluated under actual operational conditions. These consist of cryogenic electrical systems, onboard computers, inertial platforms, translational propulsive systems, et cetera.

As a result of the Gemini flights, the crews should obtain the important factor of confidence that will assure them that they can perform similar tasks required for the Apollo mission.

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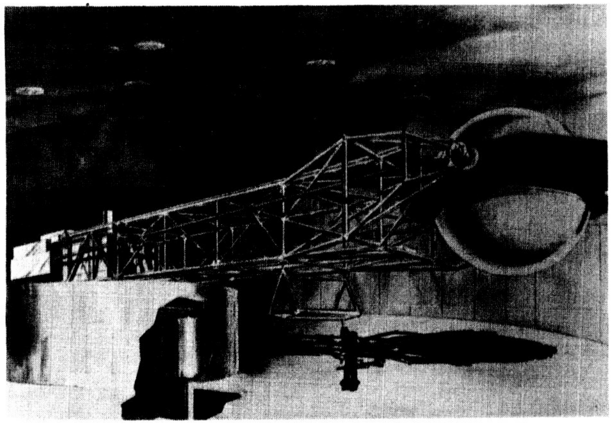

Figure 6-1

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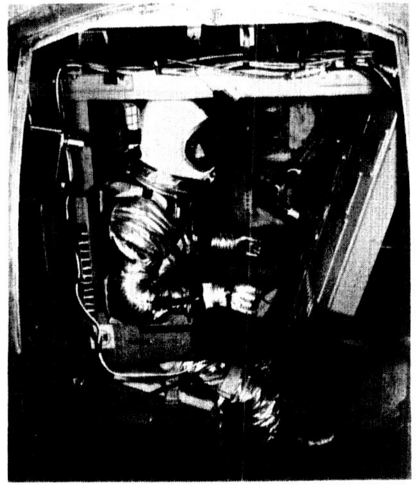

Figure 6-2

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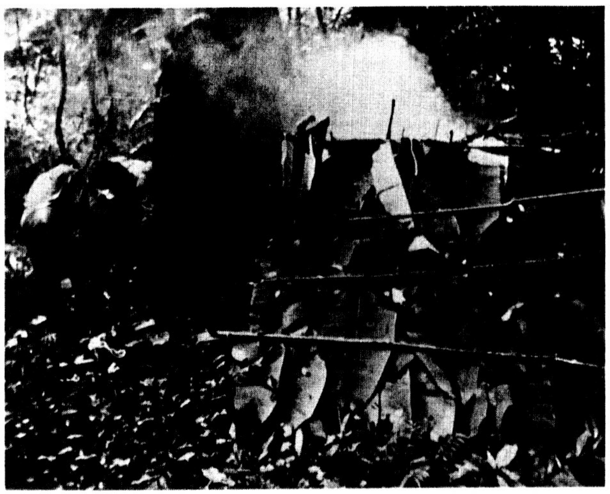

Figure 6-3

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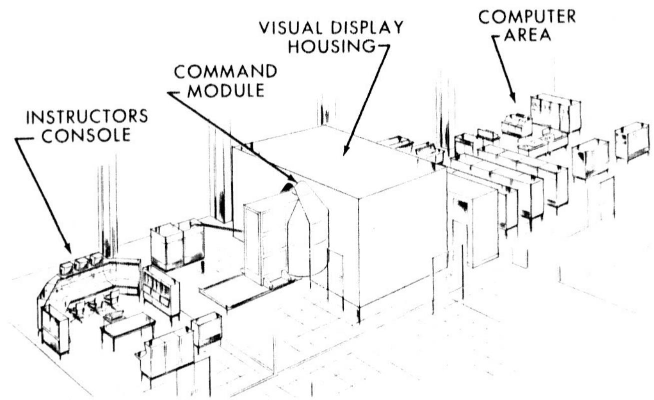

Figure 6-4

NASA S-64-856

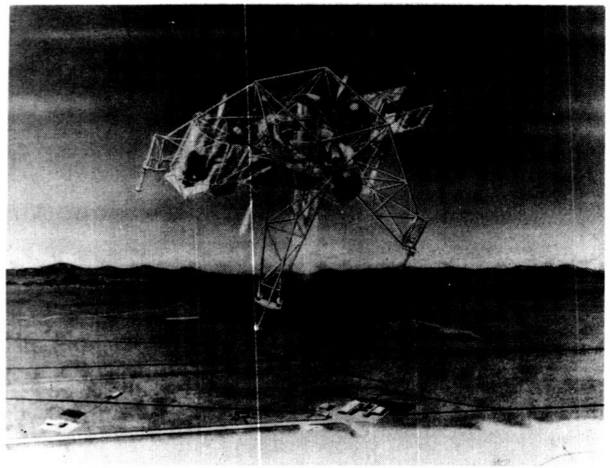

Figure 6-5

NASA S-64-4018

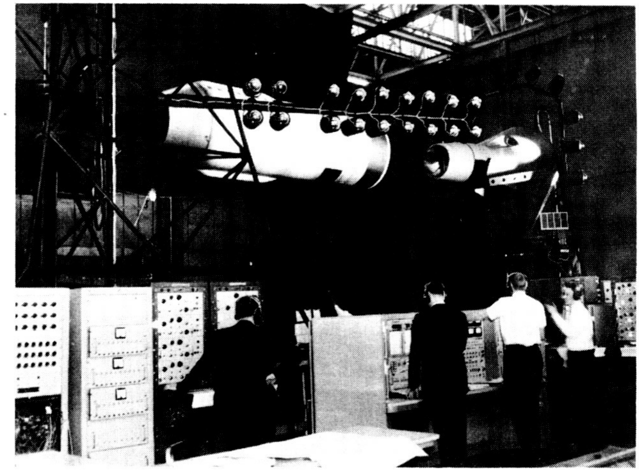

Figure 6-6